Acute Asthma and Life-Threatening Respiratory Infections in Children

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Case Presentation

- A 2-year-old child is brought to the ER by his parents with complaint of “difficulty breathing,” “chest congestion,” and “cough.”
- He has also had a fever for 2 days
- Vital signs:

  T 102°F (39°C) HR-130 RR-40 O_2-92% Room Air

Questions

- What about this child makes you nervous?
- What is the differential diagnosis?
- What are important questions to ask?
- What further studies might you want?
- How can we best manage this child?

Background

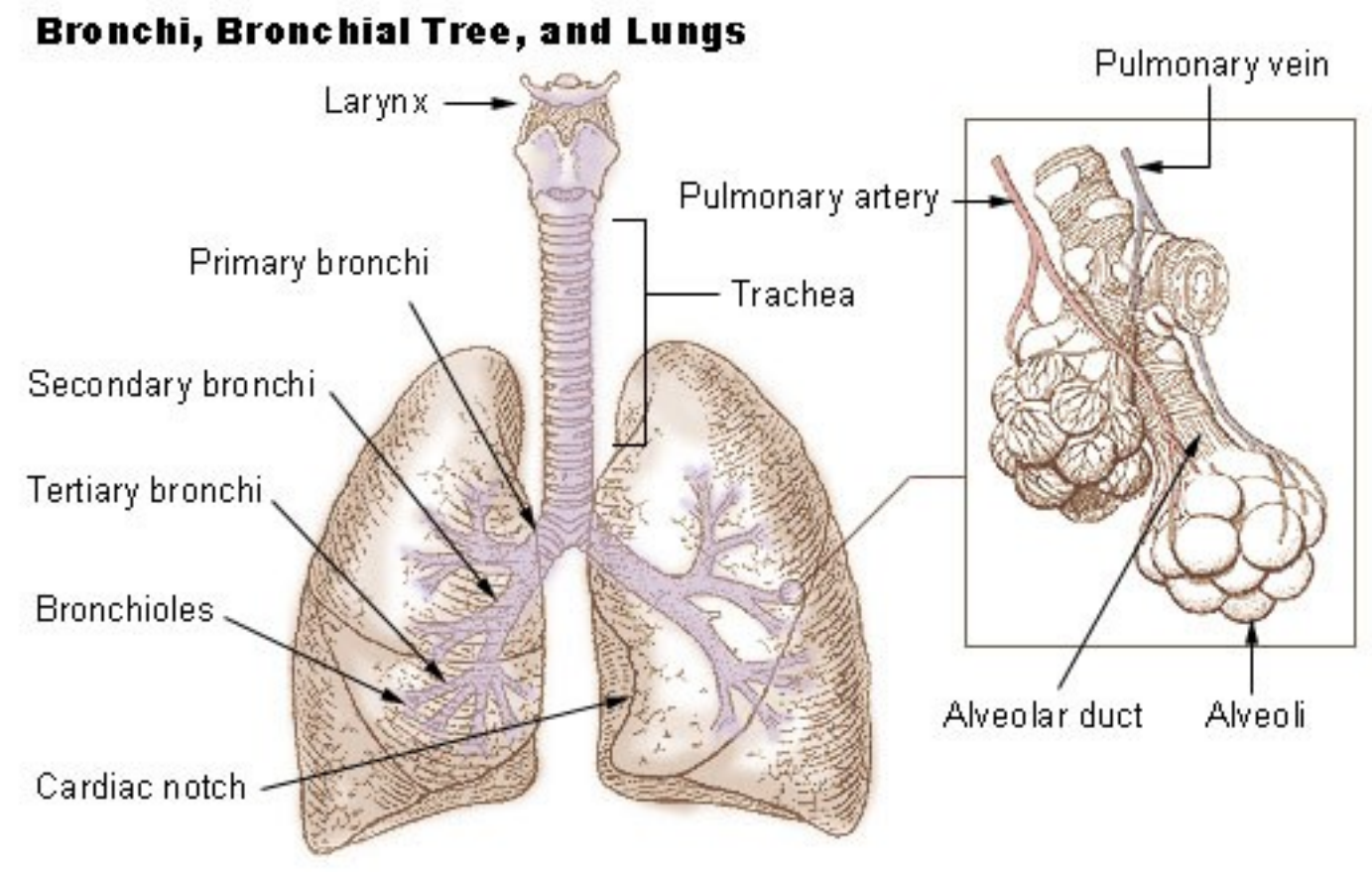
- Respiratory symptoms are extremely common in children
  - #1 reason for of ER and clinic visits both in Spain and U.S.
- Most are relatively benign
- The Challenge:

  recognize the critically (or potentially) ill children

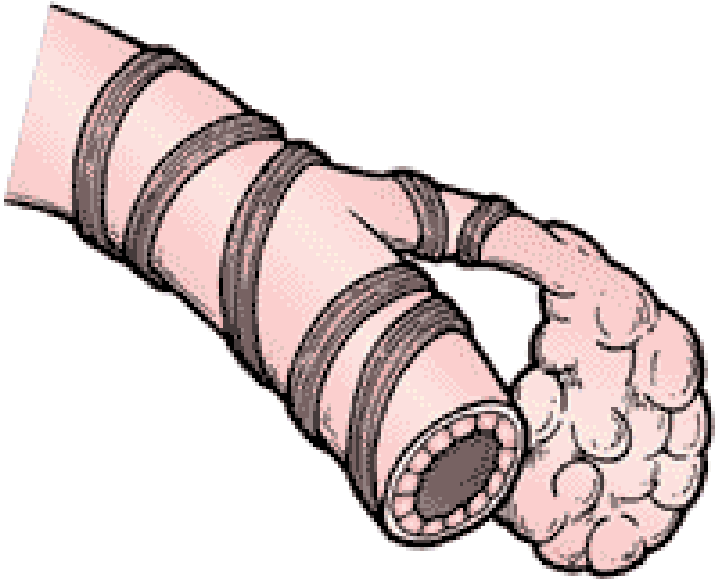
Asthma in children

- Most common chronic disease in childhood
  - Affects 6.5 million American children
  - In top 5 diagnoses for ER, clinic visits, admissions
- Inflammatory condition characterized by recurrent, reversible, small airway obstruction
- Wheezing, coughing, shortness of breath
- Triggers vary between children

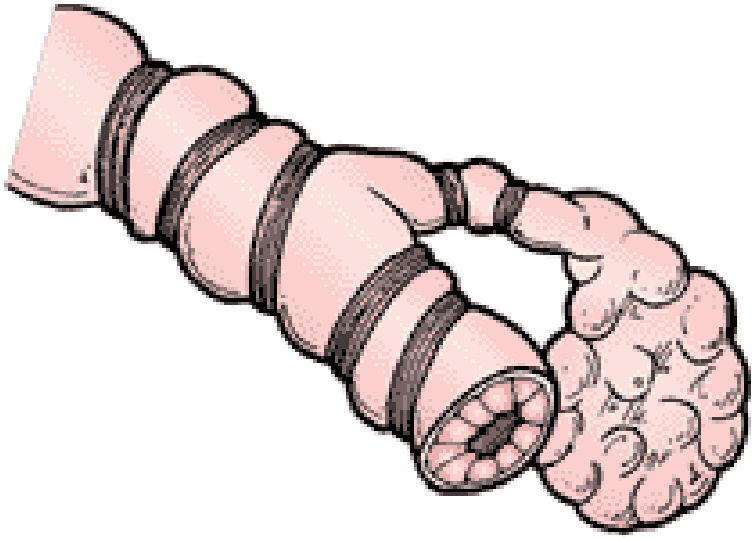
Bronchospasm in asthma



Bronchospasm in asthma



Muscles around the bronchiole have normal amount of tone.



Tightened muscles around the bronchiole cause the airway to narrow during an asthma attack.

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Risk Factors for asthma mortality

- Previous severe asthma exacerbation
- History of rapidly progressing attacks
- Male gender
- African descent
- Airway irritant exposure (tobacco or pollution)
- Low socioeconomic status
- Young mother
- No regular medical care
- Delay in care for exacerbations
- Ongoing, frequent rescue inhaler use
- Recent hospitalization for asthma
- Poor control of asthma symptoms or poor compliance with care

Asthma Exacerbation – Clinical Features

- May or may not have an obvious trigger
- Commonly rhinorrhea (rhinitis flare or URI)
- Symptoms
  - Cough
  - Chest tightness
  - Shortness of breath
  - Fatigue
  - Some patients feel or hear a wheeze

Clinical Features

Mild Exacerbations

- Respiratory rate usually normal
- O2 sats mid90s or higher
- May or may not wheeze
- Often coughing
- Comfortable

Severe exacerbation / Status

- Respiratory rate usually elevated
- O2 sats diminished (80s – low 90s)
- May or may not wheeze
- May or may not cough
- Increased work of breathing

Management of Status Asthmaticus

GOALS

- Relax bronchospasm
- Manage / Reduce inflammation
- Support oxygenation
- Maintain good air exchange

- If at all possible, avoid intubation

Management of Status Asthmaticus

- Principles have not changed significantly in the last several years
- Bronchodilators and anti-inflammatory medications

NOT ROUTINELY RECOMMENDED

- Methylxanthines (theophylline, aminophylline)
- Chest physiotherapy
- Routine chest X-ray
- Antibiotics

Medications in Status Asthmaticus

THE BRONCHODILATORS

- Inhaled β agonists
  - Albuterol or levalbuterol
  - Nebulized every 20 minutes for 3 doses, or
  - Given continuously
- Inhaled anticholinergic
  - Ipratroprium
  - Adjunct to, and given with, β agonist
  - Mucolytic effects
- Consider augment with SC epinephrine or SC terbutaline (esp. if very poor air movement)

Medications in Status Asthmaticus

- ANTI-INFLAMMATORY MEDICATION
- Crucial to successful treatment
- Oral or IV corticosteroids
  - 1 – 2 mg/kg/day, 3-7 day burst
  - Some recommend more frequent dosing in first 48 hours (0.5-1 mg/kg Q6-12h)
  - If longer than 7 days, consider taper

Medications in Status Asthmaticus

SECOND-LINE BRONCHODILATORS

Use if poor response to inhaled meds

- Injectable β agonist
  - Terbutaline
  - Given as a continuous IV infusion
  - Monitor BP, potassium, O2 saturation
- Smooth muscle relaxant
  - Magnesium sulfate
  - 25-75 mg/kg given IV over 20 minutes
  - Monitor BP, mental status, (??what else??)

Monitoring the Patient

- Work of breathing
- Vital signs (HR, RR, O_2 saturation)
- Level of consciousness
- Pulmonary exam: air movement, wheezing, I:E ratio
- Blood gas (depending on response)

- Some parameters may worsen as patient improves
  - O_2 saturation
  - Wheezing

MEDICATIONS IN STATUS

CLASS	MEDICATION	MECHANISM	USUAL DOSE	CAUTIONS / COMMENTS
Inhaled β agonist	albuterol	bronchodilator	Nebulized 2.5-5 mg x3, then 5-10 mg Q1-4 hrs - OR continuous, 0.5 mg/kg/hr	Side effects: tremors, tachycardia, palpitations, V/Q mismatch, hypoxemia
	levalbuterol	bronchodilator	Nebulized 1.25-2.5 mg x3, then 2.5-5 mg Q1-4 hrs - OR continuous, 0.25 mg/kg/hr	
Inhaled anticholinergic	ipratroprium	bronchodilator, mucolytic	Nebulized, 0.5 mg Q6-8H for 24h	Not first line; adjunct to β agonist
Systemic corticosteroid	prednisone, prednisolone, methylprednisolone	anti-inflammatory	0.5-1 mg/kg/dose Q6-12H x 48h, then 1-2 mg/kg/d	3-7 day burst Taper if <7 days
Injectable β agonist	terbutaline	bronchodilator	0.01 mg/kg SC Q15 min up to 2 doses	If very poor air exchange Can also use EpiPen
			Infusion: 2-10 mcg/kg load, 0.1-0.4 mcg/kg/hr	Titrate 0.1-0.2 mcg/kg/h every 30 min. Follow BP, potassium,
Smooth muscle relaxer	magnesium sulfate	bronchodilator	25-75 mg/kg over 20 min	

Respiratory Infections in Children

Common

- Viral URI
- *Strep* pharyngitis
- Croup
- RSV bronchiolitis
- Influenza
- Pneumonia

Potentially Life-Threatening

- Epiglottitis
- Pertussis (“whooping cough”)
- Diphtheria
- RSV bronchiolitis
- Influenza
- Pneumonia

Respiratory Syncitial Virus (RSV)

- Epidemiology: among most common infections in childhood
  - Virtually 100% of 2-year-olds have been infected
- Usual presentation: rhinorrhea/congestion, +/- fever, followed by cough, wheezing, shortness of breath
- Severe presentation / complications
  - pneumonia, resp failure
  - Young infants present with lethargy, irritability, poor feeding, apnea
  - Linked with future development of asthma
- At risk group: young infants, preterm birth, cyanotic heart disease, chronic lung disease

RSV

- Treatment / Management: supportive
  - Supplement oxygen; IV hydration
  - Bronchodilators not consistently effective
    - Recommend test dose
  - Corticosteroids not indicated
  - Antibiotics only if secondary infection
- Prevention
  - Passive immunization (RSV IG IM)
    - Monthly injections during the season
    - Limited to highest risk infants
  - Recent updates to recommendations

Cincinnati Children's Hospital Medical Center

BRONCHIOLITIS RESPIRATORY SHEET

MUST INCLUDE DATE AND TIME					
Date		Flow Rate		Initials	Signature
Time (Military Time)		O2 Delivery Device			
Oxygen Saturation (%)		Heart Rate			

TREATMENT IS RECOMMENDED FOR A SCORE OF 3 OR HIGHER

	Pre Suction Score	Post Suction Score
Respiratory Rate 0) Normal 1) Above Tachypnea Threshold (infant greater than 50)		
Accessory Muscles 0) Normal 1) Retractions/Substernal/Subcostal/Intercostal 2) Neck or Abdominal Muscles		
Air Exchange 0) Normal 1) Localized Decreased 2) Multi Areas Decreased		
Wheezes 0) None/ End Expiratory 1) Entire Expiratory 2) Entire Expiration and Inhalation		
I:E Ratio 0) Less or Equal to 1:2 1) Greater than 1:3		
Total		
Initials **Time**		
☐ Treatment not recommended. Comments:		

	Pre Treatment Score	15-30 Minute Post Treatment Score
Respiratory Rate 0) Normal 1) Above Tachypnea Threshold (infant greater than 50)		
Accessory Muscles 0) Normal 1) Retractions/Substernal/Subcostal/Intercostal 2) Neck or Abdominal Muscles		
Air Exchange 0) Normal 1) Localized Decreased 2) Multi Area Decreased		
Wheezes 0) None/ End Expiratory 1) Entire Expiration 2) Entire Expiration and Inhalation		
I:E Ratio 0) Less or equal to 1:2 1) Greater than 1:3		
Total		
Initials **Time**		
	☐ Albuterol ☐ Racemic Epinephrine	

☐ Improved with treatment. Further treatments indicated.
Comments:

Bronchiolitis Clinical Scoring

from Cincinnati Children's Hospital Clinical Guideline (http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/guidelines.htm)

RSV Immunoprophylaxis – New Recommendations

- 5 doses - adequate protection
- Infants < 24 mos with chronic lung disease
- Infants born < 32 weeks gestation
  - If < 6 mos at the start of RSV season
  - Give all 5 doses or until the end of the season
- Infants < 1 year of age with:
  - Congenital heart disease
  - Airway abnormalities
  - Neuromuscular disease
  - Immunocompromise
- Infants born 32 – 34+6 wks
  - If < 3 mos at the start of RSV season, AND
  - One of 2 risk factors present
    - Attends day care
    - Lives with sibling < 5 y/o
  - Give only until 3 months of age

Pertussis (whooping cough)

- Three phases of illness
  - Catarrhal: few days of mild upper respiratory symptoms
  - Paroxysmal: coughing fits, only ½ of patients "whoop"
  - Convalescent: cough gradually improves over weeks or months
- At risk group: young infants (unimmunized)
  - Shorter catarrhal phase
  - Present with gagging, gasping, or apnea
- Epidemiology: exclusively a human pathogen
  - Infants usually infected by adolescents or adults

whooping cough.wma

Pertussis

- Diagnosis: mainly clinical
  - Difficult organism to isolate
    - Culture remains “gold standard”
    - PCR, DFA, IgG antibody levels are other options
  - Negative result does NOT exclude disease
- Treatment
  - Macrolide antibiotics (azithromycin, erythromycin)
    - If given early (catarrhal) can shorten course
  - TMP/SMX is an alternate
  - May need IV fluids, O2 supplementation, or monitor

Pertussis – antibiotic choices

Table 3.44. Recommended Antimicrobial Therapy and Postexposure Prophylaxis for Pertussis in Infants, Children, Adolescents, and Adults[a]

Age	Recommended Drugs			Alternative
	Azithromycin	Erythromycin	Clarithromycin	TMP-SMX
Younger than 1 mo	10 mg/kg/day as a single dose for 5 days[b]	40 mg/kg/day in 4 divided doses for 14 days	Not recommended	Contraindicated at younger than 2 mo of age
1 through 5 mo	See above	See above	15 mg/kg per day in 2 divided doses for 7 days	2 mo of age or older; TMP, 8 mg/kg/day; SMX, 40 mg/kg/day in 2 doses for 14 days
6 mo or older and children	10 mg/kg as a single dose on day 1 (maximum 500 mg); then 5 mg/kg/day as a single dose on days 2 through 5 (maximum 250 mg/day)	40 mg/kg/day in 4 divided doses for 14 days (maximum 2 g/day)	15 mg/kg/day in 2 divided doses for 7 days (maximum 1 g/day)	See above
Adolescents and adults	500 mg as a single dose on day 1, then 250 mg as a single dose on days 2 through 5	2 g/day in 4 divided doses for 14 days	1 g/day in 2 divided doses for 7 days	TMP, 200 mg/day; SMX, 1600 mg/day in 2 divided doses for 14 days

TMP indicates trimethoprim; SMX, sulfamethoxazole.

[a]Centers for Disease Control and Prevention. Recommended antimicrobial agents for the treatment and postexposure prophylaxis of pertussis: 2005 CDC guidelines. *MMWR Recomm Rep.* 2005;54(RR-14):1–16

[b]Preferred macrolide for this age because of risk of infantile hypertrophic pyloric stenosis associated with erythromycin.

from *Red Book*, 28th ed. American Academy of Pediatrics, Committee on Infectious Diseases. 2009.

Epiglottitis

- Infection / Inflammation of the epiglottis
  - Complete or near-complete airway obstruction
- High fever, sore throat, dyspnea, rapid airway obstruction
- Drooling, hyperextended neck
- Severe presentation / complications
- At risk group
- Treatment / Management
- Prevention

Diphtheria

- Usual presentation: low-grade fever followed by progressive respiratory symptoms
  - Membranous nasopharyngitis
  - Obstructive laryngotracheitis
- Complications: airway obstruction, lymphadenopathy (“bull neck”), myocarditis, peripheral neuropathy
- Epidemiology: humans are the sole reservoir; endemic in many African and Asian countries
- At risk group
  - unimmunized or under-immunized

Diphtheria

- Diagnosis
  - Culture from naso- or oropharynx
  - Part of the membrane for culture
- Treatment / Management
  - Must be aggressive – can deteriorate rapidly
  - Antitoxin (equine serum): binds free toxin
  - Antibiotics: stop further toxin, prevent spread
    - 14-day course
    - Penicillin or erythromycin drugs of choice

References

- *Red Book, 2*8th ed. American Academy of Pediatrics. 2009.
- Cincinnati Children's Hospital Clinical Guidelines (www.cincinnati.org)
- U.S. Centers for Disease Control (www.cdc.gov)
- *Indicadores de Salud 2009.* Ministeria de Sanidad y Política Social. (www.msps.es)
- Pertussis audio file from www.whoopingcough.net
- Images from the American Academy of Pediatrics (www.aap.org)